## 4.11 Configuration Management

### 4.11.1 Introduction

Configuration Management (CM) is a formal system engineering (SE) management discipline that is defined as "***a management process for establishing and maintaining consistency of a product's performance, functional, and physical attributes with its requirements, design and operational information throughout its life.***"[1]  The discipline provides a structured approach to identify, control, and maintain the configuration of a system/product during its lifecycle through establishment of baselines.  A baseline is ***an agreed-to description of the attributes of a product at a point in time that serves as a basis for defining change.*** CM enables organizations to ensure the integrity of their products through all lifecycle phases.

CM is the application of good, repeatable business practices to deliver a product that meets customers' needs and enables maintenance of the product until end of service.  CM includes five fundamental practices: (1) plan CM process, (2) identify baseline elements, (3) manage approved baseline elements, (4) verify and audit configuration, and (5) provide configuration status.  These practices, along with data management, must be applied appropriately to maximize the benefits that can be obtained through CM.  Each practice has standard supporting tasks that can be tailored to meet needs.  These tasks are iterative in nature, in that CM provides a closed-loop process for managing change.  Figure 4.11-1 is the high-level CM process overview.
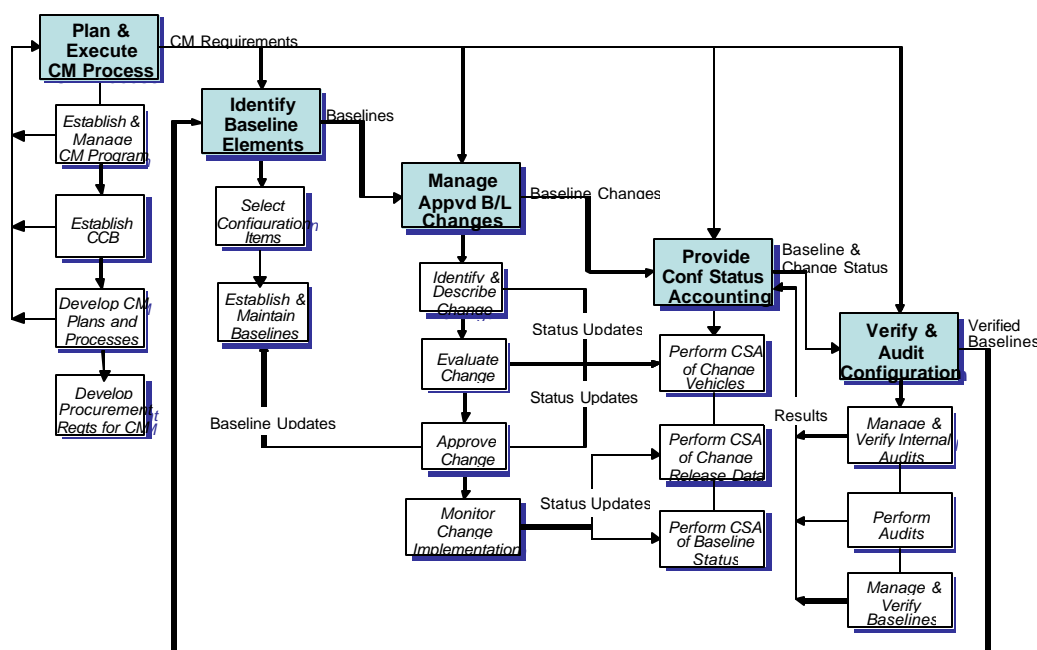


**Figure 4.11-1.  High-Level CM Process Overview**

Applying CM to a product is progressive, which means that the initial concept of the product or service is documented, collaborated, and accepted.  This adds further definition to the product

---

[1]  ANSI/EIA-649-1998, National Consensus Standard for Configuration Management.

as it moves through its lifecycle. Product definition is expressed through establishment and maintenance of baselines. The Acquisition Management System (AMS) lifecycle phases discussed in this section are (1) Mission Analysis, (2) Investment Analysis, (3) Solution Implementation, and (4) In Service Management. To support determination of how CM should be applied to a product, it is important to understand and plan accordingly for the product nature, complexity, the user, product environment, and expected lifecycle.

To effectively manage a product through each of its lifecycle phases, government and industry best practices, which support the fundamental practices discussed in this section, need to be in place. These practices to conduct CM provide the means to plan and execute activities to reach the desired goals, which include delivering a quality product that meets the documented requirements, managing costs, meeting schedules, and enabling effective maintenance. These activities, when performed properly, provide a structured approach for managing systems and products throughout their lifecycles. subsection 4.11.3 details the CM process steps shown in Figure 4.11-1.

This section describes the fundamental principles of CM in the FAA. Details of how National Airspace System (NAS) CM is performed are defined and detailed through the AMS; FAA Order 1800.66, "National Airspace System Configuration Management Policy"; and other related process documentation.

Formal CM of NAS products is established for the lifecycle of a system through inclusion of CM requirements and activities in accordance with the AMS required documentation; contract documentation, such as the Statement of Work; and CM planning documentation. Designation of responsibility begins at approval of the functional baseline during the Investment Analysis phase. Responsibility includes establishing and maintaining a CM program for each product in accordance with FAA Order 1800.66. The order includes guidance on developing CM plans, processes, and procedures and allows for tailoring of CM processes.

The activities described below comprise the practices for successfully performing CM at the FAA. The national CM process is detailed in FAA Order 1800.66, Part Two, Section II, and should be used when tailoring processes to meet program needs. This tailoring may include the provision for performing change control outside a formal configuration control board (CCB) chartered by the NAS CCB, provided that the requirements for CM in FAA Order 1800.66 are met.

The main parts of this section are the key CM process inputs, both external and internal to the SE process; the CM process tasks; and key CM outputs and Data Management. The CM Process-Based Management chart, Figure 4.11-2, depicts the logical flow of information into and out of the CM process.

| Process: **Perform Configuration Management** | ID No.: | 4.11 (iCMM PA 16) |
| --- | --- | --- |
| | Date: | September 16, 2004 |
| | Revision Date: | August 30, 2006 |

| **Next Higher Level Process:** | **Process Owner:** |
| --- | --- |
| Perform System Engineering | System Engineering Council |

**Process Objective:**

Establish and maintain consistency of a product's performance, functional, and physical attributes with its requirements, design, and operational information throughout its life.
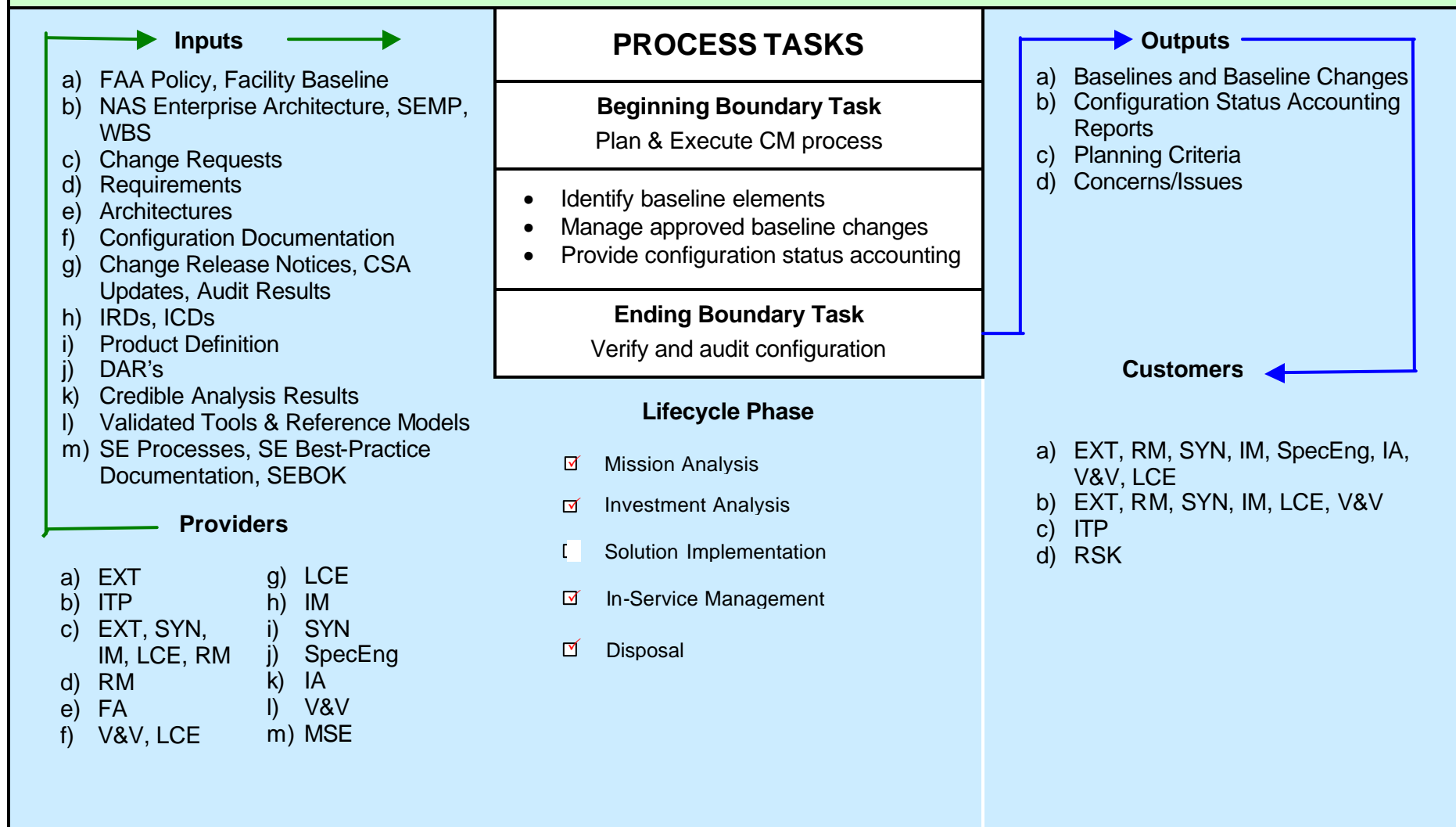
### Inputs

a) FAA Policy, Facility Baseline
b) NAS Enterprise Architecture, SEMP, WBS
c) Change Requests
d) Requirements
e) Architectures
f) Configuration Documentation
g) Change Release Notices, CSA Updates, Audit Results
h) IRDs, ICDs
i) Product Definition
j) DAR's
k) Credible Analysis Results
l) Validated Tools & Reference Models
m) SE Processes, SE Best-Practice Documentation, SEBOK

### Providers

a) EXT
b) ITP
c) EXT, SYN, IM, LCE, RM
d) RM
e) FA
f) V&V, LCE
g) LCE
h) IM
i) SYN
j) SpecEng
k) IA
l) V&V
m) MSE

## PROCESS TASKS

### Beginning Boundary Task

Plan & Execute CM process

- Identify baseline elements
- Manage approved baseline changes
- Provide configuration status accounting

### Ending Boundary Task

Verify and audit configuration

### Lifecycle Phase

☑ Mission Analysis

☑ Investment Analysis

☐ Solution Implementation

☑ In-Service Management

☑ Disposal

### Outputs

a) Baselines and Baseline Changes
b) Configuration Status Accounting Reports
c) Planning Criteria
d) Concerns/Issues

### Customers

a) EXT, RM, SYN, IM, SpecEng, IA, V&V, LCE
b) EXT, RM, SYN, IM, LCE, V&V
c) ITP
d) RSK

**Figure 4.11-2. Configuration Management Process-Based Management Chart**

### 4.11.2 Inputs

An input to CM is information that the CM process needs that provides direction; is the basis for or otherwise drives CM process activities; or requires action through one or more CM task areas.

### 4.11.2.1 External

An external input is information provided to the CM process from outside the SE discipline process.  The major external inputs to CM are as follows.

### 4.11.2.1.1 FAA Policy

FAA policy and practices govern CM.  The primary regulatory inputs to the CM process are:

- **FAA Order 1800.66.**  CM policy, FAA Order 1800.66, prescribes the requirements and details the processes and procedures to perform CM of the NAS.  The introduction of new products or services to the NAS or any changes to existing products or services must be accomplished in accordance with FAA Order 1800.66.  This policy is a standalone document and is part of the FAA AMS.

- **AMS.**  In addition to the CM policy, the AMS also addresses CM, such as developing CM criteria in the appropriate Program Plan(s).

### 4.11.2.1.2 Change Requests

Outside parties use the CM process as a conduit to request changes to FAA-managed baselines.  The requests can be:

- **Engineering Change Proposals (ECP).**  The government uses ECPs to manage allocated and product baselines.  The contractor's CCB must approve ECPs.   This CCB is generally co-chaired by both the FAA and contractor representatives or, at a minimum, has FAA approval authority before implementation of the change.

- **Requests for Deviations and Waivers.**  During product development or production, there may be instances in which deviations or waivers to requirements are needed.  The contractor will submit requests to deviate (planned) from or waive (unplanned) a specific requirement as applicable.  The contractor submits requests for deviation (RFD) or requests for waiver (RFW) to the FAA for approval using the form(s) referenced in the agreed-upon CM plan or contract documentation.  RFDs/RFWs are generally temporary and are brought into compliance at a later time.

- **Contractor Change Vehicles.**  Other contractor change vehicles affecting the change process must be documented in the contractor's/developer's approved CM plan.

- **Memoranda of Understanding (MOU).**  MOU document agreement between FAA organizations or the FAA and an external organization when no formal contractual relationship exists between the parties.  They may document a deviation in processes affecting standards or agreed-upon business practices or procedures, approval authority, or technical agreements (such as external

interfaces and data sharing).  The CM process includes MOU as source data to be kept as part of the program documentation and used to drive, validate, and verify program activity as necessary.

### 4.11.2.1.3 Facility Definition

Facility definitions are input by FAA facilities to the NAS CM process to establish and manage local facility baselines.

### 4.11.2.2 Internal

Internal inputs are information provided to the CM process from within the SE discipline processes.  The major internal inputs to CM are as follows.

### 4.11.2.2.1 Integrated Technical Planning

Integrated Technical Planning (ITP) provides the framework in the form of plans and other planning information for executing the CM process on a program or within an organization.  In particular, ITP furnishes the following:

- **System Engineering Management Plan.**  The System Engineering Management Plan (SEMP) describes the SE work activity and the schedules associated with each task.  Enterprise-level CM and related activity are captured and used by enterprise-level CM personnel to plan and execute activities affecting SE processes.

- **Configuration Management Plan.**  Configuration Management Plans (CMP) describe program CM strategy, implementation activities, and standard practices for performing CM within a program.  The ITP process (see Section 4.2) provides the strategy, activities, and practices for implementing CM within programs.

- **NAS Enterprise Architecture.**  The NAS Enterprise Architecture (NASEA) is used as the basis for the overall baseline of how the NAS appears today.  The NASEA is baselined and is the foundation of the Master Configuration Index (MCI).  The MCI represents the current national configuration of the NAS and is the basis for the CM process relationships.  Any changes to the NASEA or MCI must undergo formal change processing.  The NASEA will be evaluated for possible changes when any other baseline changes that is traceable to the NASEA.  If changes to the NASEA are required, then formal CM processing will be performed.

- **Work Breakdown Structure (WBS).**  The WBS provides a logical structure for developing the products that will be placed under CM.  This structure assists CM in establishing the Configuration Items.

- **Audit Results.**  Configuration audit results are findings from formal configuration audits, such as functional and physical configuration audits.  These findings may result in baseline changes or other actions required to meet baseline or contract requirements.

### 4.11.2.2.2 Requirements Management

Requirements Management provides requirements to CM to be managed as follows:

- **Requirements.**  NAS system requirements represent the highest level of requirements for the NAS.  Lower level requirements for all new systems must be traceable from the top level.  The CM ensures that all tasks required to maintain this traceability are executed.

- **Change Requests.**  Any request for changes to the product definition is forwarded to CM for processing.  The NAS Change Proposal (NCP), FAA Form 1800-2, is the coordination vehicle used internally to formally change NAS baseline documentation.

### 4.11.2.2.3 Functional Analysis

For the CM process, the functional architecture presents a view of how the NAS provides the services detailed in the concept of operations through the NASEA.

### 4.11.2.2.4 Synthesis

Synthesis furnishes CM products related to the solution being developed for formal release and control.  In particular, Synthesis provides the following:

- **Product Definition**.  The product definition provides Configuration Item (CI) descriptions to the CM process that are identified during the Synthesis process. The product definition documents all hardware configuration items and computer software configuration items (CSCI), including all documentation to design, build, assemble, test, modify, repair or support the product.  This includes tooling, planning, analyses, parts lists, material standards, and other product-related items.  The affected baseline determines the change vehicle to be used to update a baseline.  CM uses the product definition to establish the product baseline.

- **Change Requests.**  Any request for changes to the product definition goes to CM for processing.  The NCP, FAA Form 1800-2, is the coordination vehicle used internally to formally change NAS baseline documentation.

### 4.11.2.2.5 Interface Management

Interface Management provides interface requirements to CM to be managed as follows:

- **Interface Requirements Documents (IRD).**  IRDs are submitted to the CM process for baseline establishment and control.

- **Interface Control Documents (ICD).**  ICDs are submitted to the CM process for baseline establishment and control.

- **Change Requests.**  Any request for changes to the interface definition of the product goes to CM for processing.  The NCP, FAA Form 1800-2, is the coordination vehicle used internally to formally change NAS baseline documentation.

### 4.11.2.2.6 Specialty Engineering

Design Analysis Reports provide information to assess proposed system baseline changes.  They contain descriptions of a system's special characteristics, a list of requirements that were either validated or verified during analysis, residual risks, and candidate requirements found as a result of the analysis.

**4.11.2.2.7 Validation and Verification (V&V)**

V&V provides documentation to CM to support establishment and control of product configuration(s) undergoing the V&V process.  In particular, V&V provides the following:

- **Configuration Documentation.**  Test article and test apparatus configuration documentation is submitted to CM for retention.  This includes the configuration of test fixtures, jigs, test facilities, and tooling.  Test article configuration documentation includes, among other items, whether the article was produced to production or test documentation or built on hard or soft tooling.  The documentation is used to determine relevancy of verification results and for configuration audit purposes.

- **Test Results.**  The CM process uses test results and inspection reports to document completion of product test milestones or to close actions, or as source data during the conduct of formal configuration audits.

- **Validated Tools and Reference Models.**  All validated tools and reference models are submitted to CM to establish and maintain tool and reference model baselines.

**4.11.2.2.8 Lifecycle Engineering**

Product and change coordination documentation is managed and controlled throughout the product's lifecycle.  In particular, Lifecycle Engineering furnishes the following to CM:

- **Configuration Documentation.**  Product documentation that is generated or modified during the product's lifecycle is submitted to CM.  This includes elements of the product definition, such as configuration and interface control drawings, software design documents, version description documents, modification and maintenance records, and technical manuals.

- **Change Requests.**  Any request for changes to the product baseline after delivery is forwarded to CM for processing.  The NCP, FAA Form 1800-2, is the coordination vehicle used internally to formally change NAS baseline documentation.

- **Change Release Notices.**  CM is a closed-loop process, meaning that a change is not considered closed until actual implementation has been completed. Documentation of completion includes change release notices that specify what has been changed, approval authority, and installation or implementation date. Change release notice information is a key component of configuration status accounting.

- **Configuration Status Accounting Report (CSAR) Updates.**  CSAR updates provide the current status of MCI configuration items or work products from Lifecycle Engineering to keep CM status current.  The supporting CM process can electronically generate and provide CSARs on demand or at scheduled intervals.

**4.11.3 Configuration Management Process Steps**

This section identifies the CM process tasks and highlights the requirements for each activity.

### 4.11.3.1 Step 1: Plan and Execute CM Process

Planning for configuration management is key to successfully reaching program goals. Planning provides the basis for ensuring application of effective and efficient CM practices throughout each of the applicable SE processes. A discussion of all planning for CM appears in Integrated Technical Planning (Section 4.2), which describes the primary activities for implementing and maintaining CM.

### 4.11.3.1.1 Step 1.1: Establish and Manage CM Program

CM lifecycle management is the top-level CM activity used to implement the major CM principles over the program lifecycle. It includes coordinating and managing all tasks to implement CM principles and to conduct CM activities. CM planning determines the resources for CM activities throughout the lifecycle, establishes the mechanisms to perform the CM process, designates the responsibilities of the organizations performing the CM process, and ensures that control will be extended to vendors and contractors during equipment acquisition.

### 4.11.3.1.2 Step 1.2: Establish a Configuration Control Board (CCB)

A CCB *is the FAA authorized forum for establishing configuration management baselines and for reviewing and acting upon changes to these baselines.* A CCB ensures the functional and operational integrity of a baseline through establishment and enforcement of effective change management and control practices and processes.

Established by the FAA Administrator as the highest ranking CCB, the NAS CCB has authority to charter subordinate CCBs as necessary.

The service unit typically develops its CCB charter and operating procedures upon assignment of a NAS program or programs. Each CCB develops operating procedures according to its specific mission and needs. FAA Order 1800.66, paragraph 3.2.1.5, provides requirements for developing and maintaining CCB charters and operating procedures. Additionally, samples of current CCB charters and operating procedures are on the CM Web page (http://www.faa.gov/cm/).

### 4.11.3.1.3 Step 1.3: Develop CM Plans and Processes

CM plans and processes are to be documented in accordance with Section 4.2 (Integrated Technical Planning). Additional documents may be useful depending on the complexity of the CM tasks. Refer to FAA Order 1800.66, paragraph 3.2.2.1, for guidance on the specific requirements for CM planning.

### 4.11.3.1.4 Step 1.4: Develop CM Procurement Requirements

CM requirements of a proposed procurement are determined through reviews of procurement and planning documentation. CM deliverables must generally support management of the product during the contract and the maintenance philosophy for the procurement. Ensure that these identified requirements are incorporated into the statement of work and are itemized in contract deliverables. Additionally, review proposal responses to determine whether they meet the CM requirements and participate in post-award conferences to ensure that all parties involved have a common understanding of contract CM requirements and to resolve any issues.

### 4.11.3.2 Step 2: Identify Baseline Elements

This activity includes identifying associated work products, establishing and maintaining requirements on work products and services that result from the CM process, and

establishing requirements for controlling changes to those work products. Identifying these products provides the means to establish and maintain baselines. Systems/products are identified through SE, Integrated Technical Planning, and Synthesis processes. Key work products requiring management approval or concurrence include concepts of operation, plans, electronic data, and automated support tools.

### 4.11.3.2.1 Step 2.1 Identify Configuration

Configuration identification ***is the systematic process of selecting product attributes, organizing associated information about the attributes, and stating those attributes.*** It includes assigning and applying unique identifiers for the product and its associated documentation, as well as maintaining document revision relationships to the product configurations. Product attributes are applied to hardware, software, firmware, and their associated documentation. These attributes mature through each of the lifecycle phases and, at key milestones during those phases, are validated and incorporated into the baseline.

### 4.11.3.2.1.1 Select Configuration Items (CI)

A CI ***is an aggregation of hardware, software, processed materials, services, or any of its discrete parts that is demonstrated for CM and treated as a single entity in the CM process.*** Selecting CIs separates the elements of a system or product into individual subsets to manage their development and subsequent change. Designating CIs for FAA CM usually occurs at the major subsystem levels of the WBS or to critical items, lowest replaceable units (LRU), and releasable software code elements. The process steps for selecting CIs in the FAA are as follows (see FAA Order 1800.66, paragraph 3.3.2.1):

- Establish program and program identification

- Plan acquisition strategy

- Select configuration items

- Update Plans

### 4.11.3.2.2 Step 2.2 Establish and Maintain Baseline

The progression of a product through its lifecycle appears as a series of baselines. Key product milestones provide a snapshot of the product configuration at the respective lifecycle phase. A baseline is "an agreed-to description of the attributes of a product at a point in time, which serves as a basis for defining change."[2] The baseline includes a specific revision or version of approved and released documents, sets of documents, or electronic files (software and data) that serve as the basis for managing change. Formal baselines are established at designated times during each of the lifecycle phases, which appear in Figure 4.11-3.

Following are typical baselines that are established for an acquisition program. Because of NAS complexity, the FAA also maintains an enterprise-level, or NAS functional, baseline, which represents the top-level requirements for the NAS overall. Other FAA-unique baselines include the operational and facility baselines that are described below.

---

[2] ANSI/EIA-649-1998, National Consensus Standard for Configuration Management.

Figure 4.11-3 represents the product development process and the key CM milestones for baseline establishment and validation.
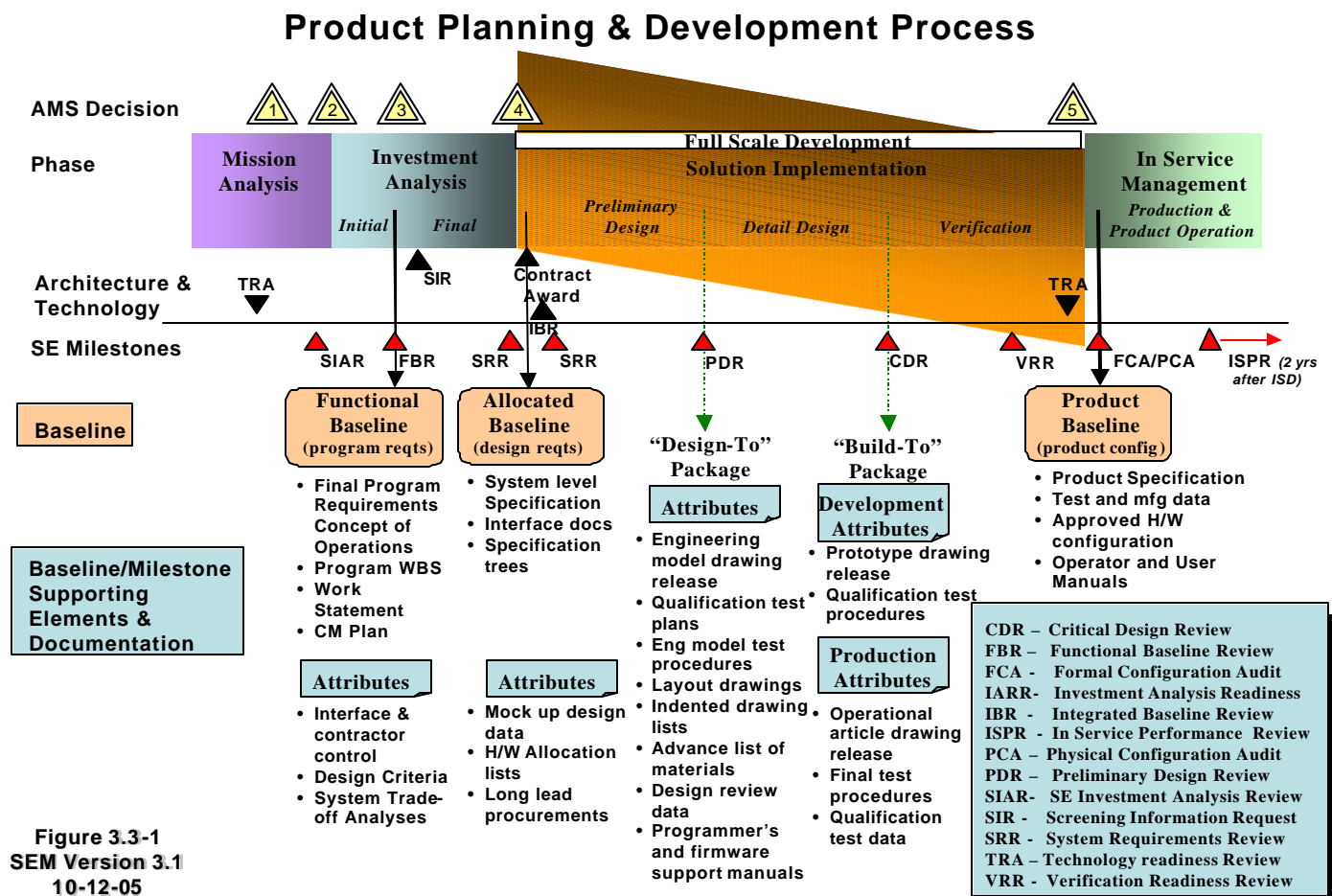
# Product Planning & Development Process



**Figure 3.3-1
SEM Version 3.1
10-12-05**

CDR – Critical Design Review
FBR – Functional Baseline Review
FCA - Formal Configuration Audit
IARR- Investment Analysis Readiness
IBR - Integrated Baseline Review
ISPR - In Service Performance Review
PCA – Physical Configuration Audit
PDR – Preliminary Design Review
SIAR- SE Investment Analysis Review
SIR - Screening Information Request
SRR - System Requirements Review
TRA – Technology readiness Review
VRR - Verification Readiness Review

**Figure 4.11-3.  CM and Product Planning and Development Process**

## 4.11.3.2.2.1 Functional Baseline

The functional baseline is ***the approved documentation describing the system's functional, performance, interoperability, and interface requirements and the verifications required to demonstrate achievement of those specified requirements.*** The functional baseline represents the functional requirements for a program and is the first formal program baseline to be established after concept exploration.  The typical milestone, which must be met before this baseline is established, is successful completion of the functional baseline review.  The functional baseline is managed through a formal control process using the change vehicle(s) documented in the developer's approved CM plan and/or the customer's formal change proposal form, if different (e.g., the NAS NCP form).  The sponsor has final approval authority over changes to the functional baseline.  The functional baseline for a NAS program is the final Program Requirements (fPR), attachment 1 to the Exhibit 300 documentation.

### 4.11.3.2.2.1.1 NAS Functional Baseline

The technical portion of the NAS Enterprise Architecture defines and translates services, capabilities, and operational improvements into design solutions and their required technical characteristics. The technical characteristics are "NAS-Level Requirements" that explicitly translate the operational needs of the agency into functional, performance, and constraint requirements that are sufficient to direct the appropriate design and development of NAS systems. NAS-Level Requirements are the highest level requirements maintained within the FAA and are initially defined during Investment Analysis. The NAS functional baseline consists of two elements: the NAS-level requirements and Final Program Requirements (see FAA Order 1800.66, paragraph 3.3.3.1).

### 4.11.3.2.2.2 Allocated Baseline

The allocated baseline is ***the approved documentation describing a CI's functional, performance, interoperability, and interface requirements that are allocated from the requirements of a system or higher level configuration item; interface requirements with interfacing configuration items; and the verifications required to confirm the achievement of those specified requirements.*** The allocated baseline represents the program's design requirements. This baseline is typically established just before contract award after the system requirements review. Generally, the allocated baseline is managed through a formal control process using the change vehicle(s) documented in the developer's approved CM plan and/or the customer's formal change proposal form. The allocated baseline for the FAA is the System Level Specification and Interface documentation that will be used for an acquisition program. Typically in the FAA, the contractor manages the allocated baseline; however, the FAA has final approval authority over changes.

### 4.11.3.2.2.3 Product Baseline

The product baseline is ***the configuration of the system or product being delivered to the customer.*** It consists of the combined performance/design documentation used CI for production/procurement. This documentation package incorporates the allocated baseline documents describing a CI's functional, performance, interoperability, and interface requirements and the verifications required to confirm achievement of those specified requirements. It also includes additional design documentation, ranging from form and fit information about the proven design to a complete design disclosure package, as deemed necessary for CI acquisition.

The milestones for establishing this baseline are completion of the formal functional audit (FCA) and the physical configuration audit (PCA). The FCA is the formal review of final test documentation and test reports, users and operators manuals, and diagnostic manual; it is also required for conducting a PCA. The PCA is the formal examination of the "as-built" configuration of a CI against its technical documentation to establish or verify the CI's product baseline. In other words, the PCA compares the actual configuration of a production representative item against the final Type C product specification, referenced documentation, drawings, software product specification, and version description document used to produce that item. The product baseline is managed through a formal control process using the customer's change vehicle as documented in the customer's organizational CM policy and plan. To manage the product baseline, the FAA uses FAA form 1800-2, NCP; the program trouble report (PTR), which captures proposed corrective action for software; and the hardware discrepancy report (HDR), which captures proposed corrective action for hardware,

**4.11.3.2.2.4 Facility Baseline**

The facility baseline is ***the information needed to identify and control changes as well as record configuration and change implementation status of all CIs under Regional CCB authority.*** There are two important categories of facility data subject to CM: facility baseline drawings and engineering data such as critical power panel schedules. Refer to FAA-STD-058, Federal Aviation Administration Standard Practice Facility Configuration Management, for specific criteria.

As discussed above, the FAA manages the NAS through the traditional functional, allocated, and product baselines. Additionally, the FAA manages the facility baseline. This baseline is an essential element of FAA planning for introducing NAS systems/subsystems. Facility baselines are a major component of the transition planning process, as described in FAA-STD-058. The complexities and variety of new projects to be implemented result in competition for floor and/or roof space, electrical power, and environmental and operational resources. Consequently, regional CMPs and CCB charters define space, power, and other resources as CIs that must be managed for each facility in the NAS.

Establishment of a facility baseline is determined by assessing the impact of Capital Investment Plan projects as well as regionally and nationally initiated changes and improvements. When required, regional CM personnel request a change through the use of an NCP to establish or change the baseline (see FAA Order 1800.66, paragraph 3.3.3.5).

**4.11.3.2.2.5 Operational Baseline**

The operational baseline is ***the approved technical documentation representing installed operational hardware and software.*** This represents the product baseline adapted to local conditions.

Operational baselines comprise the technical documentation that initially describes a delivered system and changes to it that occur as a result of in-service modifications and improvements or addition of FAA-developed documentation/tools. The operational baseline includes the product baseline and any subsequent changes to it. Operational baselines describe the system as deployed in the NAS.

The process of establishing the operational baseline begins with approval of the product baseline NCP by the responsible CCB. The operational baseline documents listed in the approved NCP are entered into the NAS MCI as the technical representation of installed operational hardware and software. This set of documents shall accurately reflect each NAS subsystem at the beginning of its service life.

Because systems entering active service need to correct problems or provide enhancements, they will use the CM process. Although any organization may identify proposed changes, only the NCP process can be used to authorize a change. When a change is approved, all documents identified in the operational baseline shall reflect that change.

New documents, tools, or controls may be added to the operational baseline at any time. Examples of new operational baseline items include aids to creating firmware; engineering or documentation release processes; item marking associated with specific sites; or additional systemwide instructions such as maintenance handbooks. New operational baseline items are added by processing a change through the NCP process.

### 4.11.3.3 Step 3: Manage Approved Baseline Changes

Configuration control is ***the systematic process that ensures that baseline changes are properly identified, documented, evaluated, and approved by the appropriate level of authority and implemented and verified***.  A change is "any alteration to a product or its released configuration documentation.  A configuration change may involve modification of the product, product information, and associated interfacing products."[3]  Documented process requirements determine the level of control.

### 4.11.3.3.1 Step 3.1: Identify and Describe Change

Changes to baselines are documented on the applicable change vehicles.  In the FAA, any person can identify a problem or suggest an improvement at any time during the product lifecycle.  The factors determining the type of change vehicle or the need for a change vehicle are the type of baseline, who is responsible for controlling the baseline, and the agreed-to CM planning documentation.  Change vehicles state the problem or need for change, the proposed change, affected CI, cost and schedule for change implementation, and so forth.  Change vehicles are uniquely identified and require the baseline elements (e.g., product identifier and document number) affected.  For NAS baseline management, the FAA uses FAA form 1800-2, which represents proposed changes to the form, fit, or function (or Class I type change) of CIs identified as part of the NAS baseline.  PTRs and HDRs are the vehicles used, primarily by operational support personnel, to correct a problem or inconsistency (or Class II type change) that does not impact any aspect of a baseline.

### 4.11.3.3.2 Step 3.2: Evaluate Change

Coordination and review of changes embody the systematic approach for ensuring the validity, feasibility, and assessment of impacts of the change.  Formal reviews capture each reviewer's name, organization, comments, date of review, and appropriate resolution of comments as applicable.  Reviews must occur before adjudication.  This approach includes reviewing changes to both formal and informal baselines (e.g., NAS baseline and work-product baseline changes).

### 4.11.3.3.3 Step 3.3: Ensure Disposition of Change

Change disposition is the conclusion by the appropriate authority that the item submitted for approval is either suitable or unsuitable for implementation or release.  CCBs serve as a forum for adjudicating changes for formal baselines.

In the FAA, the CCB structure has an established hierarchy.  The NAS CCB is the highest ranking FAA board and has the authority to charter subordinate Solution Provider, Regional, and other CCBs, such as the William J. Hughes Technical Center CCB.  The NAS CCB has general oversight responsibility for ensuring consistency across all CCBs.  The NAS CCB also resolves issues elevated from subordinate CCBs.  The NAS CCB charter and operating procedures detail the NAS CCB relationship and interaction with other chartered CCBs.

Each CCB is an independent decision-making body within its prescribed level of authority.  A CCB has decision authority for all changes affecting CIs assigned to the CCB, as listed in Appendix A of its charter as well as any other responsibilities specifically identified in the charter.  These CCBs may approve any change as long as the CI is assigned to the CCB, and the appropriate source of funding is available when

---

[3] ANSI/EIA-649-1998, National Consensus Standard for Configuration Management.

cost impact is involved.   When a source of funding is not identified, the CCB must follow agency procedures for obtaining the funds (see FAA Order 1800.66, paragraph 3.4.1).

### 4.11.3.3.4 Step 3.4: Monitor Change Implementation

An important CM function is monitoring change implementation.  This activity ensures completion and release of approved changes.

Change implementation is accomplished by closure of the Configuration Control Decision (CCD).  The CCD is the official FAA notification of CCB decisions and directives.  The CCD identifies required actions and the organizations responsible for completing either implementation of approved changes or follow-up of actions for disapproved changes.  CCD actions for approved changes may include physical incorporation of changes to affected hardware, software or facilities; approval of technical evaluations, studies, or tests; and directions for incorporating changes in baseline documentation.  The primary activities of the CCD closure process for changes to facilities or operational equipment are field modification installation and tracking.  The CCB monitors the actions listed in the CCD until all have been completed.

CCD closure consists of implementing defined actions, tracking completion of these actions, and ensuring their closeout in the appropriate information management systems (e.g., the Documentation Control Center and Maintenance Management System).  CCD actions may include approval of physical incorporation of changes to affected hardware, software, or facilities; approval of technical evaluations, studies, or tests; and directions for incorporation of changes in baseline documentation.  Field modification installation and tracking are the primary activities of the CCD closure process involving changes to facilities or operational equipment.

### 4.11.3.4 Step 4: Provide Configuration Status Accounting (CSA)

CSA is ***the systematic recording and reporting of system or product configuration status***.  CSA includes baseline change status and history for all items shown in the MCI, from initial delivery to the end of product service.  CSA reports not only communicate status, but may also support conduct of formal configuration audits when design documentation is not available or has not been updated to the current configuration.  CSA is performed at all levels of CM across a system or product lifecycle.

### 4.11.3.4.1 Step 4.1: Capture Change Data

Capturing change data, typically by using automated CM support tools, enables recording and reporting of the status and history of baseline changes from initiation through implementation.

### 4.11.3.4.2 Step 4.2: Establish Baseline Configuration Status

Once any of the baseline types is established, it can exist in two states: baseline and baseline with changes outstanding.  When the outstanding changes are incorporated into the affected baseline, they become the updated baseline.

### 4.11.3.4.2.1 Baseline

Baselines that are established in Step 2.2, Baseline Establishment and Maintenance, are identified with a configuration identification nomenclature and the baseline approval date.  For example, the original version of an FAA specification is identified as "FAA-E-2570, April 1, 1985."

### 4.11.3.4.2.2 Baseline With Changes Outstanding

Baselines with changes outstanding that have been processed through Step 3, Manage Approved Baseline Changes result is a set of independent "Approved Baseline Changes" that will be applied to modify or extend the extant baseline.  Until the approved baseline changes have been incorporated into the baseline, they are managed as independent CM products.  A baseline with changes is identified as "the original baseline configuration identification nomenclature with change X" and the date the change was approved.  For example, the original version of an FAA specification with changes is identified as "FAA-E-2570, April 1, 1985, **Change 1**, December 31, 1988."

**Tip**
      Updated baselines that have been processed through Step 3, Manage Approved Baseline Changes, become the new baseline when approved.  Updated baselines are established by integrating all the outstanding approved baseline changes when their number becomes so numerous or a single change is so large that the baseline becomes unmanageable.  The update sequence may be different than the approval sequence, with the net result that some parameter values may vary from the individual changes. The updated baseline is identified as the "original baseline configuration nomenclature with a revision identifier and the date the revised baseline was approved."  For example, an updated FAA specification is identified as "FAA-E-2570**a**, September 30, 1992."

### 4.11.3.5 Step 5: Verify and Audit Configuration

Conducting audits and quality checks ensures the integrity of the system or product. The FCA/PCA is a formal audit activity used to establish the product baseline and is discussed in Section 4.2.6 (Technical Reviews and Audits) of this manual.  Quality checks, peer reviews, or internal audits of work products are informal means for documenting and managing the quality and validity of informal organizational baselines.

### 4.11.4 Outputs

### 4.11.4.1 External

External outputs are information provided to the customer or receiving process that is outside the SE discipline processes.  Major external outputs include the following.

- **Baselines and Updated Baselines**.  The CM process provides the mechanism to establish and manage baselines.  Baselines are established at completion of each CM milestone shown in Figure 4.11-3.  Each baseline type is provided as a baseline or an updated baseline as described in subsection 4.11.3.4.

- **Baseline Changes.**  Baseline changes are provided to all CM users whenever a potential baseline change or update is pending that could impact their work product.

- **Configuration Status Accounting Reports.**  Configuration status accounting reports (CSAR) provide the current status of MCI configuration items or work products.  CSARs can be generated electronically and provided on demand or at scheduled intervals by the supporting CM process.

**4.11.4.2 Internal**

Internal outputs are information provided to the customer or receiving process that is within the SE discipline processes.  Major internal outputs from CM are detailed below.

**4.11.4.2.1 Requirements Management**

- **Baselines and Updated Baselines.**  After approval by the responsible authority, requirements are to be incorporated into the appropriate baselines.

- **Baseline Changes.**  Baseline changes are provided to all CM users whenever a potential baseline change or update is pending that could impact their work product.

**4.11.4.2.2 Synthesis**

- **Baselines and Updated Baselines.**  The Synthesis process uses baselines or baseline subsets to manage changes, promote visibility, and communicate status of the baseline or its components.

- **Baseline Changes**.  Baseline changes are provided to all CM users whenever a potential baseline change or update is pending that could impact their work product.

- **Configuration Status Accounting Reports.**  CSARs provide the current status of configuration items or work products.  They can be generated electronically and provided on demand or at scheduled intervals by the supporting CM process.

**4.11.4.2.3 Risk Management**

Program or system concerns and issues found during the CM process are outputs to the Risk Management process.  These concerns and issues are typically found during review of changes or at the CCB meeting and require resolution outside of the CM process.

**4.11.4.2.4 Lifecycle Engineering**

- **Baselines.  The Lifecycle Engineering process uses baselines to manage changes, promote visibility, and communicate status of the baseline or its components.**

- **Baseline Changes.**  Baseline changes are provided to all CM users whenever a potential baseline change or update is pending that could impact their work product.

- **Configuration Status Accounting Reports.**  The CM process provides the Validation and Verification process with CSARs that communicate the status of the current baseline, including associated change history.  CSARs are used specifically to document configuration status of specific products by effectivity and to document consistency between that specific item and its associated configuration documentation.  This is done to establish that an adequate CM process is in place to provide control of the delivered configuration from the producer.

**4.11.4.2.5 Validation and Verification**

- **Baselines.**  The Validation and Verification process uses baselines to determine the extent that demonstration and test articles represent the baseline configuration.

- **Approved Baseline Changes.**  Baseline changes are provided to all CM users whenever a potential baseline change or update is pending that could impact their work product.

- **Configuration Status Accounting Reports.**  The CM process provides the Validation and Verification process with CSARs that communicate the status of the current baseline of delivered products, including associated change history. CSARs are used during verification activities to ensure that the modified product meets the documented requirements.  CSARs are also used when design documentation is not available or has not been updated to the current configuration.

**4.11.4.2.6 Integrated Technical Planning**

The CM process receives as input requests for information.  Integrated Technical Planning receives CM planning criteria for such documents as the SEMP and supporting Technical Plans.

**4.11.4.2.7 Interface Management**

- **Baselines and Updated Baselines**.  The Interface Management process uses baselines or baseline subsets to manage changes to system interfaces, promote visibility, and communicate status of the baseline or its components.

- **Configuration Status Account Reports.**  CSARs provide the current status of CIs or ICDs.  They are generated electronically and provided upon demand or at scheduled intervals by the supporting CM process.

**4.11.4.2.8 Specialty Engineering**

- **Baselines.**  The Specialty Engineering process uses baselines to support analysis of proposed systems or associated components. The baseline is the basis for any changes, such as design features, operating maintenance, or installation procedures.

- **Baseline Changes.**  Baseline changes are provided to all CM users whenever a potential baseline change or update is pending that could impact their work product.

**4.11.4.2.9 Integrity of Analyses**

- **Baselines.**  The Integrity of Analyses process uses baselines to support the appropriate application of the required level of fidelity, accuracy, and confirmed results of analyses that other SE processes perform.

- **Baseline Changes.** Baseline changes are provided to all CM users whenever a potential baseline change or update is pending that could impact their work product.

### 4.11.5 Data Management

Data Management (DM) is ***the preparation, approval, distribution, and storage/archiving of recorded information of any nature/type (administrative, managerial, financial, and technical) regardless of medium or characteristics.***

### 4.11.5.1 Control of Digital Data

DM includes controlling information in digital format to ensure integrity of digital representations of system or product information and other related data.  DM shall include effective file and database management; unique identification of documents, files, and document representations; retention of essential file and version relationships; data status; and controlled access to digital data.  Digital data is information prepared and maintained electronically and provided by electronic data access, interchange, transfer, or on electronic media.  It should be noted that the control of digital data involves applying tailored requirements based on the CM practices (Figure 4.11.1) in this section.

The FAA has a number of policies regarding control of information, and this documentation should be referred to when planning for control of electronic data.  If there is no applicable policy, refer to Section 5.6 of EIA 649 to develop criteria.  There is, however, documented practice for managing work products within programs.

### 4.11.5.2 Control of Work Products

In the context of managing NAS products or systems, work products are supporting products of the NAS, while not formally part of a NAS product's configuration.  Work products developed within the program/project requiring management's signature must undergo CM.  Work products associated with the program/project to undergo CM are identified, and requirements for controlling changes to those work products are established.  CM of key work products identified should be applied consistently throughout the organization.  Key work products are derived from the AMS and are determined by the project leader.  Key work products encompass, but are not limited to, the required AMS documentation, including the Implementation Strategy and Planning document, requirements, contract documentation, CCB charters and operating procedures, plans, policies, procedures, and formal meeting minutes.   As with any CM activity, work product procedures should be documented and included in planning documentation to ensure consistency and quality of work products.

### 4.11.5.2.1 Identification of Work Products To Be Controlled

In accordance with agency or organizational policy or practices, each work product must be assigned a unique identifier and tracked using version or revision levels (including preliminary versions and drafts).  File-naming conventions are to be consistent and easily traceable to the product title.

Electronic files are to be maintained to allow traceability to historical records of individual files.  Each new version or revision of a file must have its own unique identifier.  The original file will not be overwritten.  See FAA Order 1800.66, paragraph 3.3.2.5 Data Management, for detailed procedures.

**Tip**

    Suggested minimum formats for document working versions are the following: The original file would be named "FileName_v1.0," and revisions would be named "FileName_v1.1," "FileName_v1.2," "Filename _v1.3," and so forth.

**Tip**

    Work product revisions requiring signature for formal release should begin, for example, at version 1.0 or revision 0 for the initial release of a document.  The next revision for that document released for signature would be submitted as version 2.0 or revision A.   Working review versions between major updates would be named versions 1.2, 1.3, 1.4, etc.

### 4.11.5.2.2 Review of Work Products

Formal review and version control of identified key work products are required to ensure accuracy, completeness, and traceability of changes.  Key work products and associated change history are to be maintained in the program support library (PSL).  Each person responsible for preparing a work product is to perform version control for that product.

### 4.11.5.2.3 Perform Quality Checks

Before being signed or released, key work products must be processed through quality assurance and/or peer review.  Proof of quality assurance and/or peer review is to be maintained with the work product in the PSL.

### 4.11.6 Configuration Metrics

CM process metrics support evaluation of the effectiveness of a CM program and CM process improvement requirements.  CM metrics criteria should be associated with each CM process task.  The metrics support the program goals and provide good insight into process improvements.

Examples of effective CM metrics are:

- CM Plan development milestones
- Extent of adherence to the CM plan
- Number of changes processed, adopted, rejected, or open
- Status of open change requests
- Classification of change requests (i.e., Critical, Normal, Documentation, etc.)
- Number of deviations or waivers
- Cycle time for change processing
- Rate of baseline changes
- Time for CCD closure after approval
- Response time for comments on data manage documents

## 4.11.7 References

1. Blanchard, B. *System Engineering Management.* Second Edition. John Wiley & Sons, Inc., 1998.

2. *National Consensus Standard for Configuration Management.* EIA-649. Arlington, VA: Electronic Industries Alliance, August 1998.

3. *National Airspace System Configuration Management Policy.* FAA Order 1800.66. Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, January 1999.

4. Samaras, Thomas. *Configuration Management Deskbook.* Advanced Applications Consultants, Inc., 1988.